REMARKS

Claims 3, 4, 6-8 and 12-14 have been rejected under 35 USC 103(a) as being unpatentable over Shirota et al in view of Yamaguti et al. Claims 5 and 9-11 have been rejected under 35 USC 103(a) as being unpatentable over Shirota et al in view of Yamaguti et al and further in view of Su et al. Claim 15 has been rejected under 35 USC 103(a) as being unpatentable over Shirota et al in view of Yamaguti et al and further in view of Sawamoto et al. Applicant respectfully traverses these grounds of rejection and urges reconsideration in light of the following comments.

At the outset, Applicant wishes to point out to the Examiner that Applicant is not relying on JP 11-052550 as a priority document. This reference was sent to the Patent Office as part of an Information Disclosure Statement in compliance with Applicant's duty to disclose relevant prior art. The Examiner is respectfully requested to sign the Form PTO-1449 provided with this reference and provide Applicant with a copy of the signed Form PTO-1449.

As explained previously, the present invention is based on the discovery that the formation of scale on a cathode and generation of sludge in alkaline water after electrolyzed alkaline water and untreated water are mixed in lines and tanks can be avoided by conducting an electrolysis process under specific conditions. That is, Applicant has discovered that by restricting the water flow rate to the cathode compartment of an electrolyzer to 40mL/min. per ampere of current and feeding softened water to the cathode compartment, acidic and alkaline electrolyzed water are produced which avoid the formation of scale on the cathode and the generation of sludge after the electrolyzed alkaline water and untreated water are mixed in lines and tanks downstream from the electrolysis process.

In a first embodiment of the present invention, in an electrolyzer having an anode chamber containing the anode, a

cathode chamber containing a cathode and a diaphragm separating the chambers, softened water is fed to the cathode chamber, unsoftened water containing an electrolyte is fed to the anode chamber and electrolysis performed in the electrolyzer to produce acidic and alkaline electrolyzed water. The flow rate of the softened water to the cathode chamber is controlled to be no greater than 40 mL/min. per ampere of loading current.

In another embodiment of the present invention, an intermediate chamber is provided in the electrolyzer and is separated from the anode compartment by a first diaphragm and a cathode compartment by a second diaphragm. Unsoftened water containing an electrolyte is fed into the intermediate chamber while softened water is fed to the cathode chamber and unsoftened water is fed to the anode chamber. Electrolysis is performed under the conditions that the flow rate of the softened water to the cathode chamber is no greater than 40 mL/min. per ampere of loading current to produce acidic and alkaline electrolyzed water as discussed above for the first embodiment.

In the present invention it is critical that the flow rate of the water fed to the cathode chamber be no greater than 40 mL/min. per ampere of loading current and that only softened water is fed to the cathode chamber. This enables the electrolyzer to be operated such that scale does not deposit on the cathode during the electrolysis process and the precipitation of sludge or scale in downstream lines or tanks after the electrolyzed alkaline water is mixed with untreated water can be prevented. It is respectfully submitted that the prior art cited by the Examiner does not even present a showing of prima facie obviousness under 35 USC 103(a) with respect to the presently claimed invention.

As discussed previously, the Shirota et al reference is directed to a manufacturing method and apparatus for making alkaline ionized water and acidic water. In this reference, a supplying system 7a of raw material water for producing acidic

water is connected to the anode cell 2a and water selected from water for industrial use, tap water and well water is supplied to the anode cell.

As illustrated in Figure 1-A, the cathode compartment 2c is fed alkaline ionized water from a container bath 4 with a raw material water make-up through line 7a'. The alkaline ionized water fed to the cathode compartment is recirculated back into the cathode compartment and discharged out of line 9a when a desired pH value has been obtained. Although this reference discloses that water, from which a cation and an anion are removed, i.e., pure water, is preferably used as a raw material water fed to the container bath 4, this reference has no disclosure with respect to the use of softened water as a feed to the cathode compartment and controlling the feed of the softened water to the cathode compartment at the claimed flow rate.

Softened water is water in which the calcium, magnesium and other divalent and higher cations found in ordinary water are exchanged for sodium ions, using a cation exchange resin. This process actually slightly increases the number of cations and anions in the solution but eliminates the polyvalent materials that cause scale on the electrodes. This is different from "pure" water in which both anions and cations have been removed. Producing softened water with an anion exchange resin loaded with sodium is much less expensive than actually removing both anions and cations to produce deionized "pure" water. Therefore, Applicant once again wishes to reiterate that Shirota et al does not disclose the two critical features of the present invention. That is, the feeding of <u>softened</u> water to the cathode chamber and the feeding of softened water at a flow rate not greater than 40 mL/min. per ampere loading current.

The Yamaguti et al reference discloses a method and device for producing electrolytic water in which the electrolytic water is produced by controlling the electrolytic degree of electrolytic water discharged from an electrolyzer

in accordance with the pH value, electric conductivity, oxidation-reduction potential and ion concentration. This reference discloses that the ratio between the flow rate of water into the cell and the applied current can be varied to obtain electrolytic water having a desired pH value. This reference actually advocates the regulation of the relative turn-over rate of the cathode and anode compartments, in combination with the addition of salt to <u>both</u> sides of the membrane (column 2, lines 15-24) to produce highly alkaline and acidic water at appropriate levels. That is, at column 2, lines 60-ff, this reference states:

> "By controlling the electrolysis on the basis of the electric conductivity and/or oxidation-reduction potential detected from the raw water and/or electrolytic water by use of the sensor means, the pH value and/or discharge flow quantity of the acidic and/or alkaline water can be effectively controlled.
>
> The strength of electrolysis can be freely controlled by regulating the discharge flow ratio of the acidic water to the alkaline water and/or the quantity of electrolytic load electricity applied to the electrolyzer in accordance with the electrolyzing condition or the electrolytic degree of the electrolytic water discharged from the electrolyzer. The discharge flow ratio of the acidic water to the alkaline water can be varied by moving the barrier membrane by which the anode and cathode chambers are partitioned to vary the capacities of the anode and cathode chambers. Also, the discharge flow ratio of the acidic water to the alkaline water can be varied by controlling the flow control means provided on at least one of the discharge passages from the anode and cathode chambers."

The control equation at column 8, line 39, is expressed in flow rate and not amps. Wherever current is expressed in this reference, it is given as a set value of 30 amps at 16 volts such as at column 7, lines 24-50. The closest disclosure this reference has to the present invention is at column 12, lines 20-31, where the obvious is stated: that the amount of electricity per flow rate of the raw water can be increased by decreasing the flow quantity of the raw water.

However, there is no suggestion in this reference that anything advantageous would be obtained by feeding softened water into a cathode compartment at a flow rate of no more than 40 mL/min. Therefore, this reference adds nothing to the primary Shirota et al reference.

The Su et al reference has been cited by the Examiner as disclosing a method for producing electrolyzed water in which the desired pH range of the anode water is from 2 to 4. However, Su et al has no disclosure which would motivate one of ordinary skill in the art to modify the primary Shirota et al and Yamaguti et al references in a manner that would yield the presently claimed invention. That is, Su et al has no disclosure with respect to the criticality of feeding softened water to the cathode compartment at the claimed flow rate. Therefore, this reference in combination with the previously discussed references, does not even present a showing of prima facie obviousness under 35 USC 103(a).

The Sawamoto et al reference has been cited by the Examiner as teaching a method of adding a supporting electrolyte to the cathode liquid. However, like the previously discussed references, this reference has no disclosure with respect to controlling the flow rate of softened water back to a cathode chamber in order to minimize the deposit of scale on the cathode and precipitation in lines and tanks downstream from the electrolysis process when the alkaline water is mixed with raw water. Therefore, this reference, in combination with the previously discussed references, does not present a showing of prima facie obviousness under 35 USC 103(a).

Although the references cited by the Examiner do not present a showing of prima facie obviousness under 35 USC 103(a), Applicant once again wishes to emphasize that evidence is of record in the present application which would be more than sufficient to rebut any showing of prima facie obviousness under 35 USC 103(a).

Pages 9-12 of the present specification contain an Example of the present invention and comparative processes which are operated outside of the scope of the present claims but within the scope of the prior art cited by the Examiner. In Comparative Example 1, the flow rate of water introduced into the cathode compartment was higher than the claimed upper limit. In Comparative Example 2, unsoftened water was fed to the cathode compartment. The remaining process parameters in the Comparative Examples are the same as that of Example 1.

As discussed in Comparative Example 1, after 48 hours of operation, it was impossible to continue electrolysis because of the high voltage occurring from the scale formed on the cathode. As shown in Table 1 on page 12 of the present specification, in Comparative Example 2, a much larger amount of precipitate was formed as contrasted with that of Example 1 and the filtering time for the alkaline electrolyzed water produced in Comparative Example 2 was greater than 7 times longer than that of Example 1. This objective test data clearly establishes the criticality of both the feeding of softened water to the cathode compartment and the feeding of the softened water within the claimed flow rate. None of the prior art cited by the Examiner suggests that both parameters are necessary in providing the unexpected results associated with the present invention, i.e., the prevention of the formation of scale on the cathode during prolonged operation and the prevention of precipitation and lines in tanks downstream from the electrolysis process after the alkaline electrolyzed water is mixed with raw water. Therefore, Applicant respectfully submits that the patentability of the presently claimed invention has been established.

The Examiner is respectfully requested to reconsider the present application and to pass it to issue.

Respectfully submitted,

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